NOTES ON THE BIOLOGY OF *TETRASTICHUS HAGENOWII* (HYMENOPTERA, EULOPHIDAE) A PARASITE OF COCKROACH OOTHECAE[1]

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Oothecae of *Periplaneta australasiae* were found parasitized by *Tetrastichus hagenowii* in the building of the Department of Parasitology, of the University of Costa Rica, San Jose. This is the first record of this eulophid in this country.

On 5 October 1971, 33.3% of 24 oothecae collected from the edges of mop boards in our laboratory were found with mature larvae of these parasitic wasps. In a second group of egg cases dissected the same date, and collected mostly from window frames in the same place, 51.9% of 52 were found to be parasitized.

A culture of these microhymenopterons was established to study the biology of the species and to compare our observations with those made in other countries. In addition observations were continued for a year on the naturally occurring population of the wasps in the laboratory.

Individual exposures (Table 2) with mated wasps on nine oothecae of *P. australasiae* yielded from 34 to 90 wasps with an average of 63.3; and from seven oothecae of *Eurycotis biolleyi* 12 to 88 with an average of 52.3.

The wasps were not at all attracted to oothecae removed from *Blatella germanica.* In the oothecae of *P. australasiae* and *E. biolleyi* there were pupae of the wasps that failed to complete their development.

The number of wasps observed by us per egg capsule was very similar to those reported by other workers for *P. australasiae*; 40 to 50 (Cameron, 1955) and 50 (Roth & Willis, 1954) (Table 1). The average number of wasps emerged from *P. australasiae* was a little higher than for *E. biolleyi.*

The average sex ratios of the wasps from isolated oothecae (Table 2) were from *P. australasiae* 38% males and 62% females; and from *E. biolleyi* 32% males and 68% females. In both cockroach species of isolated oothecae the number of wasp males was about half that of the females the number of males from *E. biolleyi* was slightly lower than from *P. australasiae.*

Longevity of adults was also studied (Table 3). The average longevity of males was 6.33 days, varying from 4 to 11 days. Females lived from 12 to 37 days, averaging 14.5

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Table 1. Number of *Tetrastichus hagenowii* emerged per oothecae in several species of Blattaria

Species	No. of exposed oothecae	No. of females ovip.	Mean no. of wasps emerged	Range	Author
Eurycotis floridana	3	20	648	606-685	Roth & Willis, 1954
Nauphoeta rhombifolia	1		73		Roth & Willis, 1960
Parcoblatta sp	2		100		Edmunds, 1955
Periplaneta americana			100		Roth & Willis, 1960
Periplaneta americana			140		Roth & Willis, 1960
Periplaneta americana			25		Roth & Willis, 1960
Periplaneta americana			33	7-38	Usman, 1949
Periplaneta americana			71		Roth & Willis, 1960
Periplaneta americana	4	20	204	164-261	Roth & Willis, 1954
Periplaneta americana				30-40	Cameron, 1955
Periplaneta americana	39		93	12-187	Edmunds, 1955
Periplaneta australasiae				40-50	Cameron, 1955
Periplaneta australasiae			+50		Roth & Willis, 1960

Table 2.

No. and % of emerging wasps	Number and percent of adult *Tetrastichus* that emerged from indicated oothecae of *P. australasiae* and *E. biolleyi*.									
	1	2	3	4	5	6	7	8	9	mean
					P. australasiae					
Males:										
No.	14	46	35	16	34	16	22	19	15	24.1
%	33.3	60.5	53.8	17.6	56.7	24.2	64.7	24.1	16.7	(38%)
Females:										
No.	28	30	30	42	26	50	12	60	75	39.2
%	66.7	39.5	46.2	72.4	43.3	75.8	35.3	76.0	83.3	(62%)
Total adults	42	76	65	58	60	66	34	79	90	63.3
					E. biolleyi					
Males:										
No.	2	23	28	10	8	18	27			16.6
%	16.7	26.1	41.2	23.8	27.6	32.1	38.0			(32%)
Females:										
No.	10	65	40	32	21	38	44			35.7
%	83.3	73.9	58.8	76.2	72.4	67.9	62.0			(68%)
Total adults	12	88	68	42	29	56	71			52.3

days. Males generally died in 3 to 4 days. It is interesting to note that the feeding of the wasps on sugar, honey or substances from the oothecae did not extend the lifespan of them, in comparison with unfed adults.

Sexual behavior of males was characterized by visual and antennal stimulation first, and vibrating of wing before and after copulation took place. Mating was done rapidly, the male when mounting the female had to lean backwards in order to copulate. The female bent her abdomen upward when receptive and so helped the rather small male accomplish mating. Often, several males tried to copulate at the same time with the same female or even with one another.

Oviposition probably occurred on the second day after emergence of the adults. No special selection of the oothecae exposed to the wasps was noticed, they even oviposited in empty egg capsules. The females touched the oothecae with their antennae and valvae, this lasted for approximately half an hour, then actual oviposition occurred in a short time; from a few seconds to a few minutes.

Adults emerged in 39 days from an egg case that had been exposed to the wasps for 6 days. Two of 3 oothecae kept with the hymenoptera yielded adults in 27 days, the third one in 33 days.

We observed the pupation and development of mature larvae by removing them from parasitized egg cases and placing them in petri dishes with moistened cotton. By this method ninety larvae were followed through the process of getting rid of fecal materials which happened in 1 to 2 days and pupation that took 5 days. The pupal stage lasted from 17 to 22 days.

Table 3. Longevity of adults of *Tetrastichus hagenowii* emerged from oothecae of *Periplaneta australasiae* (male/female)

Ootheca No.	No. wasps emerged	No. of male and female wasps that died at the indicated days: 1	2	3	4	5	6	7	8	9
1	65	0/0	1/2	0/20	10/3	4/0	0/8	0/3	0/2	0/3
2	58	0/0	0/1	0/0	16/9	0/4	0/10	0/6	0/5	0/6
3	34	0/0	0/1	0/0	7/0	8/6	0/1	0/5		
4	66	0/0	14/6	1/5	0/14	0/17	1/7	0/1		
5	60	0/0	0/0	2/1	2/2	4/1	17/1	6/1	1/2	0/1

Table 3. (Continued)

Ootheca No.	No. wasps emerged	No. of male and female wasps that died at the indicated days: 10	11	12	13	14	15	16	17	18
1	60	0/0	0/2	0/7						
2	58	0/1								
3	34									
4	66									
5	60	1/3	1/1	0/2	0/0	0/0	0/0	0/1	0/2	0/1

Table 3. (Continued)

Ootheca No.	No. wasps emerged	No. of male and female wasps that died at the indicated days: 19	20	21	22	23	24	25(*)	34
5	60	0/2	0/2	0/1	0/0	0/0	0/0	0/1	0/1

Note (*)=no deaths occurred during the indicated period.

It is interesting to note the similarity in our observations and those made by other authors, specially concerning sexual behavior (Edmunds, 1955; and Roth & Willis, 1960). However important variations were found relating sex proportions, the number of males was lower in both species than the number reported by other authors (Usman, 1949; Cameron, 1955; Edmunds, 1955; and Roth & Willis, 1954).

Arrhenotokia was not observed in our wasp cultures. Oothecae of *P. australasiae* were exposed to several unmated wasps but none was ever parasitized.

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ABSTRACT:—*Tetrastichus hagenowii* is reported from Costa Rica naturally parasitizing oothecae of *Periplaneta australasiae.* Laboratory tests show that this hymenopteron is also well adapted to oothecae of *Eurycotis biolleyi.* An average of 63.3 *Tetrastichus* adults emerged from *P. australasiae* oothecae and 52.3 from *Eurycotis biolleyi.* The sex ratios of the wasps emerged from isolated oothecae of *P. australasiae* was 38% males and 62% females and from *E. biolleyi* 32% males and 68% females. The average longevity of *Tetrastichus* males is 6.3 days and for females 14.5 days. The pupal stage lasted from 17 to 22 days.—Mario Vargas V. & Francisco Fallas B., Departamento de Parasitologia, Facultad de Microbiologia, Universidad de Costa Rica.

Descriptors: Hymenoptera; Eulophidae; *Tetrastichus hagenowii;* San Jose, Costa Rica. Biology, sex ratios; parasitic on Blattaria: *Periplaneta australasiae, Eurycotis biolleyi.*

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